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The invention relates to a method and an apparatus to the purification of gases, in particular of wet gases, by Auskondensation undesirable gas components.

The purification of gases is in many ranges of the technology, in particular of great importance in process technique.

For the elimination undesirable gas components from a gas stream usually physical and chemical laundries become applied. When examples for such methods can become the gas cleanup by means of suitable adsorbents, by molecular sieves or by absorption in high-hygroscopic liquids mentioned.

An other prior art process to the gas cleanup causes the Auskondensation of the undesirable gas components by cooling of the gas stream.

The cooling of the gas on to the condensation of the undesirable gas components required temperature, which can be cleaned, becomes achieved by the use of refrigerating machines. With such plants will however desired to reduce the external energy employment necessary for the Gaskühlung.

A frequent used technology exists in the reduction of the driving power necessary for the refrigerating machine by cold recuperation. This made by precooling the still unpurified warm gas (crude gas) with cold gas (clean gas), already cleaned, over an heat exchanger (CR). In this way achieved becomes that the refrigerating machine gets along due to the already reduced difference between the temperature of the precooled crude gas and the required condensation temperature with smaller energy employment.

A similar method is known from the DE 40 01 710 A1. With this method becomes two cooling and/or. Heat accumulator masses along the flow channel of the gas used, of those first of the cooling and/or. Precooling the crude gas and second of the heating of the cooled down and cleaned clean gas serve, whereby the first storage mass heated and the second

storage mass cools down. By periodic switching of the flow direction of the gas stream thus likewise a better utilization of energy becomes achieved.

Particularly with the purification wet gases, with those condensed, however the risk exists the water already with higher temperatures than the undesirable components during the cold recuperation that the heat exchanger (CR) on the crude gas side freezes. This adverse process becomes additional accelerated by the fact that the clean gas current over the heat exchanger usually is on a very low temperature level.

The reduction of this problem special heat exchangers became developed for the cold recuperation. These special designs are however expensive and do not lead not in all cases to the avoidance of the freezing up problem. In some cases must be done therefore to even perfect without a cold recuperation, so that the external energy employment cannot become reduced.

The invention is the basis the object to indicate a method and an apparatus which make an inexpensive purification possible also from wet gases by Gaskühlung.

The object becomes according to claim 7 dissolved with the process according to claim 1 and the apparatus. Advantageous embodiments of the method and the apparatus are subject-matter of the Unteransprüche.

Recognized became according to invention that can become avoided by the use of a modified method of the cold recuperation during the gas cleanup a freezing of the heat exchanger in a simple manner. By this modification the use of expensive special heat exchangers is required no longer. The method can become also in cases used, was perfect excluded in which so far a cold recuperation.

With the invention process the crude gas in an heat exchanger, which can be cleaned, is precooled and subsequent in a refrigerating machine up to a temperature cooled, with which undesirable gas components from the gas condense. By condensing the undesirable components the cleaning effect becomes achieved, so that cooled down clean gas becomes obtained. Precooling the crude gas in the heat exchanger made as through clean gas already cooled down with the prior art processes. Heated clean gas admixed with the present process the clean gas before its passage, already cooled down, by the heat exchanger, which becomes obtained after the passage of cooled down clean gas by the heat exchanger, becomes according to invention.

With the invention process thus at least a part of the clean gas already led past the heat exchanger becomes branched after the passage by the heat exchanger. This branched part will the clean gas before the passage by the heat exchanger admixed, in order to increase its temperature. Thereby can depending upon present temperature, flow and wet conditions of

the crude gas the temperature on the clean gas and/or. Secondary side of the heat exchanger optimum adjusted become. In particular no additional external energy employment, for example a supply of electric current, is required by the method. By suitable adding of the warmer clean gas to the colder clean gas before the heat exchanger, present after the heat exchanger, the temperature on the clean gas side of the heat exchanger can become so adjusted that on the one hand a freezing of the heat exchanger on the crude gas and/or. Primary side avoided becomes and a sufficient precooling of the crude gas takes place on the other hand nevertheless.

Preferably the admixture quantity of heated clean gas becomes an in such a manner selected with the invention process that the heat exchanger straight does not freeze. Thereby the utilization of energy of the method becomes optimized. The admixture quantity knows for example bottom attention of the characteristic of the heat exchanger, which is precalculated flow rates and the conditions of temperature.

In an other preferable embodiment the temperature of the clean gas becomes immediate before the passage by the heat exchanger detected, and the admixture quantity of heated clean gas on the basis of the detected temperature so controlled that this temperature becomes approximate constant held.

In an other embodiment either the cooled down clean gas before the passage can become by the heat exchanger or the heated clean gas planned for the admixture or both by an additional warm element heated. This warm element preferably consists of an heat exchanger, which becomes operated by ambient heat or waste heat of the refrigerating machine.

The apparatus according to invention to the gas cleanup covers an heat exchanger with a primary and a secondary side, a refrigerating machine, a first connecting element between the output of the refrigerating machine and an input of the secondary side of the heat exchanger, a second connecting element between an output of the secondary side of the heat exchanger and the first connecting element, and a rule element.

With this apparatus the output of the refrigerating machine is over the first connecting element, in particular a gas line, with the input of the secondary side of the heat exchanger connected. From the output of the secondary side of the heat exchanger in particular an other gas line is, a compound to the first connecting element prepared over the second connecting element. By this compound the heated clean gas the colder clean gas incoming outgoing from the heat exchanger into the heat exchanger can become admixed. The rule element serves that. Control and/or. Control of the admixture quantity and is for example in form of a control valve performed.

Of course the connecting elements can consist for example different lines with corresponding branches of different individual elements, as in the fig shown.

Preferably a temperature sensor is to the detection of the temperature of the clean gas provided before the input of the secondary side of the heat exchanger, which in compound with a control circuit the rule element steers to the adherence to a predeterminable target temperature of the clean gas incoming into the heat exchanger.

In other embodiments an additional warm element is to the heating of the clean gas provided at the first connecting element and/or second connecting element. This warm element preferably consists of an heat exchanger, which uses the ambient heat or the waste heat of the refrigerating machine.

Further an auxiliary cleaning stage can be provided in the first connecting element (6) and/or between the primary side of the heat exchanger (1) and the refrigerating machine (2). The here used auxiliary cleaning element can be for example an activated charcoal filter.

In the invention process and the associated apparatus an inexpensive standard can become heat exchangers for the cold recuperation used. By the return from warmed up clean gas to the cold clean gas before the heat exchanger the inlet temperature of the clean gas can become during the cold recuperation so controlled that the crude gas side does not freeze.

Case this to the generation of a sufficient cooling effect at the heat exchanger required is, can an heat exchanger with larger exchangeflat used become. Are by the use of a standard construction unit the additional costs for this magnification, compared with the costs for special heat exchangers, of subordinate importance.

The invention process and the apparatus according to invention offer in particular the advantage that they make a gas cleanup possible with a regenerative cold procedure. This is to be preferred to a gas cleanup without heat recovery each cases, since the reduction of the refrigerating machine possible by precooling and the reduction of the operating cost lower the annual overall costs significant.

With the invention process a rational energy employment becomes possible due to the cold recuperation. Straight one in cases, was possible in which so far because of the risk of the freezing of the heat exchanger no cold recuperation, can become by the invention process and the associated apparatus a significant reduction of the external energy employment during the gas cleanup achieved.

The method is technical “robust”, insensitive against disturbances, and for different gas compositions more applicable.

The invention process and the apparatus according to invention become subsequent again explained in an embodiment in compound with the fig.

The fig shows the schematic flow chart of the Gaskühlung during the gas cleanup in accordance with an exemplary embodiment of the instant invention.

The incoming wet crude gas flow is precooled first in a standard heat exchanger 1 (CR I), in order to out-condense the majority of the contained water vapor. With an initial temperature of the crude gas of for example T = Nm 3 /h (standard cubic meter per hour, related to 0 DEG C) here CR I a cooling<> of the crude gas on approx. knows 20-40 DEG C with a relative humidity of phi = 100% and a flow of Q = 2000 by the heat exchanger. 2-17 DEG C achieved become. Thereby can in the present example in the flow 3 after the heat exchanger approx. 66% of the humidity of the gas separated, condensed as waters, become.

By the cooling of the crude gas in the heat exchanger CR I becomes the energy and/or. Cold need of the refrigerating machine of the main cool stage 2 reduced. The warm one delivered in the heat exchanger CR I by the crude gas becomes received (cold recuperation), of the clean gas.

As heat exchanger CR I becomes a prefered standard heat exchanger from the climatic or process engineering used.

The precooled (raw) gas becomes then purified in a second heat exchanger (CR II) in the refrigerating machine 2 cooled and. Typical values for the clean gas obtained after the cooling and purification amount to T = -40 DEG C and phi = 100%. Approx. 33% of the original humidity result in the second heat exchanger CR II as ice. This egg and/or. Egg/ water mixture becomes over the discharge 11 remote.

The cold clean gas becomes subsequent, as from the fig apparent, in the countercurrent the crude gas by the heat exchanger CR I guided and precools this - like described above - in the heat exchanger CR I of the cold recuperation.

Here the cold clean gas before the passage by the heat exchanger CR I becomes over a bypass blower and the control valve 4 warmer clean gas admixed. This clean gas feedback made preferably temperature-controlled and the prevented freezing up of the heat exchanger.

The warmer clean gas becomes from the heat exchanger CR I leaving clean gas branched, which was warmed up by precooling the crude gas. This heated clean gas becomes by a compressor 5 compressed and over the control valve 4 the cold clean gas admixed.

With the numeral 10 are in the fig cheque valves referred.

In the present example the cold clean gas warm clean gas, which exhibits temperature of T = -10 at the location of the admixture still another DEG C, becomes admixed. The warm clean gas after leaving the heat exchanger CR I has here a temperature of T = 10-30 DEG C and a

relative humidity of phi = 0.2-2%. The admixture made here with a flow within the range of 1500-3000 Nm< 3> /h.

In an other embodiment additional warm elements can be in the circuit of the clean gas provided, in order to be able to produce in certain cases sufficient high temperatures on the clean gas side of the heat exchanger CR I. These additional elements can be for example at positions 8 and 9 in the fig provided.

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1. Methods to the gas cleanup, cooled with which a crude gas in an heat exchanger (1), which can be cleaned, becomes precooled and subsequent in a refrigerating machine (2) on a temperature, with which condense undesirable gas components from the gas, so that cooled down clean gas becomes obtained, whereby precooling the crude gas in the heat exchanger (1) becomes by clean gas made, characterised in that the clean gas before its passage, already cooled down, already cooled down, by the heat exchanger (1) heated clean gas admixed, which becomes obtained after the passage of cooled down clean gas by the heat exchanger (1).

2. Process according to claim 1, characterised in that the admixture quantity of heated clean gas in such a manner selected becomes that the heat exchanger (1) does not freeze straight.

3. Process according to claim 1 or 2, characterised in that the temperature of the clean gas immediate before the passage by the heat exchanger (1) detected and by control of the admixture quantity of heated clean gas constant held becomes.

4. Process according to one of claims 1 to 3, characterised in that the cooled down clean gas before the passage by the heat exchanger (1) by a warm element additional heated becomes.

5. Process according to one of claims 1 to 3, characterised in that the heated clean gas for the admixture by a warm element additional heated becomes.

6. Process according to claim 4 or 5, characterised in that as warm element an heat exchanger used becomes, the ambient heat or waste heat of the refrigerating machine (2) uses.

7. Apparatus to the gas cleanup, comprising

1. an heat exchanger (1) with a primary and a secondary side,
2. a refrigerating machine (2),
3. a first connecting element (6) between the output of the refrigerating machine (2) and an input of the secondary side of the heat exchanger (1),

4. a second connecting element (7) between an output of the secondary side of the heat exchanger (1) and the first connecting element (6), and
5. a rule element (4).

8. Apparatus according to claim 7, characterised in that the rule element (4) a control valve is.

9. Apparatus according to claim 7 or 8, characterised in that before the input of the secondary side of the heat exchanger (1) a temperature sensor provided is.

10. Apparatus according to claim 9, characterised in that the rule element (4) with a control circuit connected is.

11. Apparatus after one of the claims 7 to 10, characterised in that at the first connecting element (6) an additional warm element provided is.

12. Apparatus after one of the claims 7 to 11, characterised in that at the second connecting element (7) an additional warm element provided is.

13. Apparatus according to claim 11 or 12, characterised in that the additional warm element an heat exchanger is, which becomes by ambient heat or operated by waste heat of the refrigerating machine (2).

14. Apparatus after one of the claims 7 to 13, characterised in that in the first connecting element (6) and/or between the primary side of the heat exchanger (1) and the refrigerating machine (2) an auxiliary cleaning stage provided is.